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A new species of *Hygrocybe* in section *Firmae* from Western Ghats, India

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Abstract — *Hygrocybe natarajanii*, a new species of *Hygrocybe* section *Firmae* collected from the Uppangala forest of Western Ghats of Karnataka, India is described and illustrated. Both macro- and microscopical features of this new species are compared with similar or closely related taxa viz., *Hygrocybe boothii*, *H. firma*, *H. neofirma*, *H. brunneosquamosa*, and *H. brunneosquamulosa*.

Key words — *Agaricales*, *Basidiomycota*, *Hygrophoraceae*, macrofungi

Introduction

The genus *Hygrocybe* (Fr.) P. Kumm. in the family *Hygrophoraceae* is well represented throughout the world. *Hygrocybe* species with dimorphic spores and basidia, which are classified in section *Firmae*, are primarily tropical and subtropical in distribution. Section *Firmae* includes a wide diversity of forms including an alamellate species from Ecuador (Læssøe & Boertmann 2008). Neotropical species of *Hygrocybe* in section *Firmae* were studied by Cantrell & Lodge (2001) and Lodge & Ovrebo (2008), while paleotropical species with dimorphic spores and basidia were described by Berkeley & Broome (1871) and Corner (1936) and Young (2002) and revised by Pegler & Fiard (1978), Pegler (1986), and Singer (1957). In India, twenty-two species of *Hygrocybe* have been reported from different regions (Manjula 1983, Natarajan et al. 2005). The most notable record of the species of *Hygrocybe* from India was provided by Leelavathy et al. (2006), who described 25 species in Kerala State, including 10 new species. Only one of the species found by Leelavathy et al. (2006), *H. alwisii*, was in section *Firmae*. During our studies in the Western Ghats region from Karnataka State we collected a specimen that differs macro-

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and microscopically from previously described *Hygrocybe* species in section *Firmae*. This species is described below as new to science.

Materials and methods

The description and illustrations are based on the type specimen collected from the Uppangala forest of Western Ghats of Karnataka. Handmade sections were obtained from the dried specimens, later revived in 3% KOH, and mounted in 2% Phloxine. Approximately 50 basidiospores obtained from a spore print were measured; extreme values are given in parentheses. The type specimen is deposited in the Herbarium of Madras University Botany Laboratory (MUBL). The colour terminology used is that of Kornerup & Wanscher (1978).

Taxonomy

Hygrocybe natarajanii Senthil. & Kumaresan, **sp. nov.** PLATES 1, 2

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Pileus 2–3 cm diametro, convexus, depressus, ultimus foramina, luteolus, superficie tomentosus, atrorubineus, margine non-striatus. Lamellae decurrentes, luteolus, 4.5 mm latae, subdistantes, crassus, duabus ordinibus lamellularum intermixtae, margine concolori. Stipes 5–14 cm × 2–5 mm, superficie lutea pallida, cylindricus, compressus, laevis, cavus. Contextus pilei hyphis 3–6 µm diametro, hyalinae, parietibus tenuibus. Sporae dimorphae; macrosporae 12.3 ± 1.2 × 8.5 ± 0.5 [(10–)10.5–14(–15) × (7.5–)8–9(–9.5) µm, Q = 1.4], ellipsoideae, hyalinae, parietibus tenuibus, laevis, guttulis refractives; microsporae (4.5–) 5–7(–8.5) × 3.5–5.5(–6) (6.0 ± 0.8 × 4.0 ± 0.5) µm, Q = 1.5, ellipsoideae, similis ad macrosporae. Basidia dimorpha; macrobasidia 55–68.5 × 11.5–15.5 µm, clavata, 4-spora, hyalinae, guttulis numerosis; microbasidia 37–44.5 × 5.5–8.5 µm, cylindrico-clavata, similis ad macrobasidia. Margo lamellaris fertilis. Cystidia nulla. Trama hymenophoralis regularis, ex hyphis 62–279 × 10–42 µm. Pileipellis cutis ex hyphis repentibus 3–12 µm diametro, composita, trichodermis, est hyphis 15–102 × 3–12.5 µm, cylindricus, septatus. Fibulis abundantibus.

HOLOTYPE: INDIA, Karnataka State, Maanadukka, Uppangala Forest, on ground (soil), G. Senthilarasu & V. Kumaresan (MUBL 3428).

ETYMOLOGY: This species is named in honour of late Prof. K. Natarajan, Centre for Advanced Studies in Botany, University of Madras, India.

Pileus 2–3 cm diam., convex, broadly, shallowly depressed at the disk, finally perforated with age; surface dry and covered by dark ruby red (12F8), tomentose squamules (especially noticeable towards the margin) on light yellow (3A5) ground; margin regular, decurved, crenate, not striate. Lamellae subdecurrent to decurrent, pale yellow (3A3), ≤ 4.5 mm broad near the stipe, thick, subdistant, with lamellulae of two lengths; edge concolorous, even. Stipe 5–14 cm × 2–5 mm, equal, slightly attenuated towards the apex, cylindric with a slightly compressed apex, fistulose; surface light yellow (3A5), smooth. Context ≤ 2 mm thick at the disk.

Plate 1. *Hygrocybe natarajanii* basidiomata (holotype).
a. In situ in Uppangala forest. b. Detail of tomentose squamules on pilei.
Photos G. Senthilarasu

Basidiospores dimorphous: macrospores 12.3 ± 1.2 × 8.5 ± 0.5 [(10–)10.5–14 (–15) × (7.5–)8–9(–9.5) µm, Q = 1.4], ellipsoid, hyaline, thin-walled, smooth with few refractive guttules; microspores 6.0 ± 0.8 × 4.0 ± 0.5 [(4.5–)5–7(–8.5) × 3.5–5.5(–6) µm, Q = 1.5], ellipsoid, similar to macrospores. Basidia dimorphous: macrobasidia 55–68.5 × 11.5–15.5 µm, broadly clavate, bearing four large sterigmata ≤ 10.5 × 3.5 µm, hyaline, with numerous refractive guttules; microbasidia 37–44.5 × 5.5–8.5 µm, narrowly cylindric-clavate, bearing four large sterigmata ≤ 8 × 2 µm, similar to macrobasidia. Lamellar edge fertile. Cystidia absent. Hymenophoral trama regular, with parallel, hyaline, thin-walled, 3–7.5 µm diam hyphae intermixed with large (62–279 × 10–42 µm), thin-walled, hyaline, narrowly stalked cylindric-clavate to ventricose elements. Subhymenial layer well developed, ≤ 10 µm wide, interwoven. Pileal surface a cutis of radially parallel hyphae, 3–12 µm diam, inflated to 25 µm diam, forming a disrupted trichodermial palisade underneath the tomentose squamules; individual elements 15–102 × 3–12.5 µm, of unbranched, cylindric, septate hyphae, with brown intracellular pigment. Pileus trama tightly interwoven, thin-walled, hyaline hyphae, 3–6 µm diam, inflated to 13 µm diam. Clamp-connections present on most hyphae.

Habitat - On ground, gregarious or caespitose, in wet evergreen forest, 12° 30' N and 79° 39' W, 500 masl.

Discussion: The characteristic features of *H. natarajanii* are the presence of dark ruby tomentose squamules over a small, light yellow perforated pileus, very long and slender stipe, caespitose growth, and strongly dimorphic spores and basidia. Dimorphic spores and basidia are characteristic features of section *Firmae*. The disrupted tomentose to squamulose pileal surface is due to the development of uplifted fascicles of long, unbranched, cylindric, septate hyphae with brown intracellular pigment.

Hygrocybe boothii A.M. Young (Young 2002) resembles *H. natarajanii* in having a somewhat similarly sized and shaped basidiome with a scaly pileus. However, its bright red pileus and short (4.5–8.5 cm) red stipe distinguish it from *H. natarajanii* with its yellow pileus densely covered with ruby red squamules and its longer (5–14 cm) yellow stipe. Besides the morphological characters, *H. natarajanii* has smaller macro- (12.3 × 8.5 µm vs 14.3 × 10.6 µm) and microspores (6 × 4 µm vs 7.5 × 5.1 µm) and somewhat narrower microbasidia (5.5–8.5 µm vs 9–9.5 µm) than *H. boothii*.

Hygrocybe natarajanii resembles *H. firma* (Berk. & Broome) Singer (Pegler 1986), first described from Sri Lanka and also reported from Australia (Young 2005) and Malaysia (Corner 1936). Both *H. firma* and *H. natarajanii* have a convex to applanate or depressed, tomentose to scurfy squamulose pileus and yellow lamellae. In addition, their macrospores, macrobasidia, microspores,

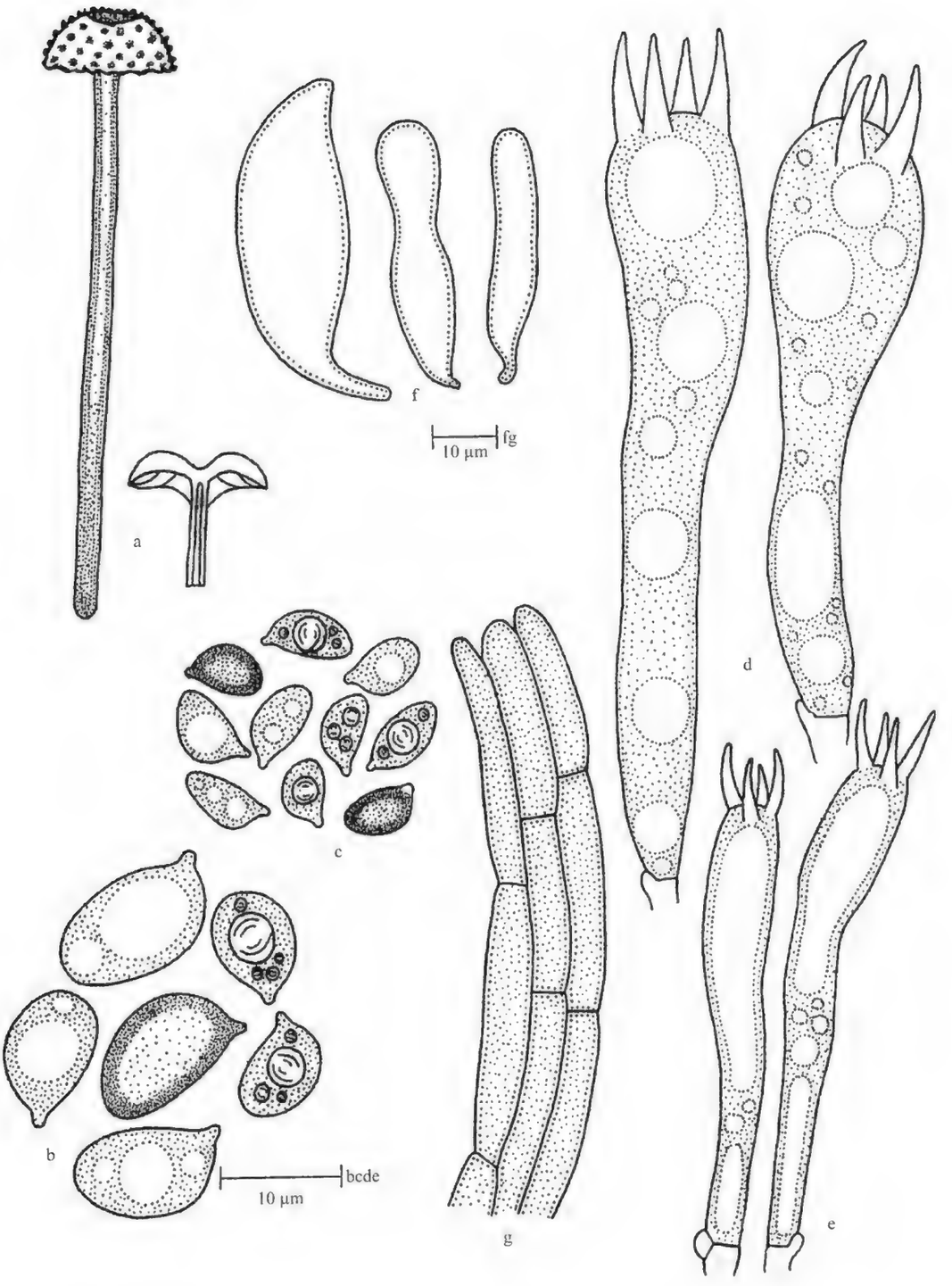

PLATE 2. *Hygrocybe natarajanii* (holotype).
a. Habit ×1, and longitudinal section. b. Macrobasidiospores. c. Microbasidiospores. d. Macrobasidia. e. Microbasidia. f. Tramal elements. g. Epicuticular hyphae. Scale bar = 10 µm.

and microbasidia are of similar size. However, the *H. firma* type collection (Thwaites 880 from Peradeniya, Sri Lanka) clearly differs from *H. natarajanii* in having a larger (1–4 cm vs 2–3 cm) minutely squamulose orange red to scarlet red pileus lacking brown pigments in the trichoderm and a short (3–8 cm vs 5–14 cm), concolorous or paler stipe. Besides the colour and size differences, the spores of *H. firma* are more distinctly dimorphic in shape (with oblong ellipsoid to ellipso-cylindric macrospores and ovoid to broadly ellipsoid microspores), while in *H. natarajanii* both macro- and microspores are similarly ellipsoid.

Hygrocybe natarajanii closely resembles *H. neofirma* S.A. Cantrell & Lodge (Cantrell & Lodge 2001) and *H. brunneosquamosa* Lodge & S.A. Cantrell (Cantrell & Lodge 2001) in the tomentose pileus, a trichodermial pileipellis with brown contents in the trichodermial elements, and similarly sized and shaped microspores. However, *H. neofirma* and *H. brunneosquamosa* basidiomes are larger than those of *H. natarajanii* and with a broader aspect (a 1–2 pileus diameter to stipe length ratio rather than >2–3) and a shorter stipe (2.2 cm in *H. neofirma* and 3.3 cm in *H. brunneosquamosa* vs 5–14 cm in *H. natarajanii*). *Hygrocybe brunneosquamosa* is further distinguished by its squarrose grayish brown to cinnamon brown pileus and brown lamellae. Microscopically, *H. natarajanii* macrospores are smaller (10–15 µm vs 13.5–19 µm in *H. neofirma* and 15–21 µm in *H. brunneosquamosa*) and macrobasidia (55–68.5 µm vs 32–56 µm) and microbasidia (37–44.5 µm vs 24–28 µm) are larger than in *H. brunneosquamosa*.

Hygrocybe natarajanii macroscopically resembles *H. brunneosquamulosa* Leelav. et al. (Leelavathy et al. 2006) described from Western Ghats of Kerala, India in having a convex, perforated, squamulose pileus and yellow lamellae and stipe. However, *H. brunneosquamulosa* is distinguished by olive brown to dark brown squamules on a yellowish brown ground, a shorter stipe (1.5–9 cm vs 5–14 cm), and an entire carpophore that turns black on drying. In addition, the absence of dimorphic spores and basidia clearly distinguishes *H. brunneosquamulosa* microscopically.

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